CEREAL SCIENCE *today*

OCTOBER 1961 • VOL. 6 • NO. 8 • 60C

ASSOCIATION OF CEREAL CHEMISTS

DEAR SIR:

The following information on the Sedimentation Test may be useful to your readers.

This laboratory recently tested 257 samples of wheat, 160 of which were of the 1961 crop and 97 of the 1960 crop or older. All were commercial blends of 25,000 to 200,000 bushel lots. Identical samples were milled on a Buhler mill and on a Tag-Heppenstall set at 0.023 inch roll clearance as specified by Zeleny (Pinckney, A. J., Greenaway, W. T., and Zeleny, L. *Cereal Chem. 34:* 16–25, 1957). The flour from the Buhler mill was baked into one pound loaves using a lean formula straight dough process with machine moulding. The results are summarized below.

Crop Year	1960 or older	1961
Number of Samples	97	160
% Protein, Low	10.40	9.30
% Protein, High	15.40	14.60
% Protein, Average	12.96	12.17
Sedimentation, Tag Milled, Low	29	26
Sedimentation, Tag Milled, High	55	64
Sedimentation, Tag Milled, Average	43.5	43.9
Sedimentation, Specific (Sed./% Protein) Tag	3.36	3.61
Sedimentation, Buhler Milled, Low	41	38
Sedimentation, Buhler Milled, High	67	69
Sedimentation, Buhler Milled, Average	51.2	54.4
Sedimentation, Buhler Milled, Specific (Sed./% Protein)	3.95	4.47
Loaf Volume, Buhler Flour, Low	2315	2195
Loaf Volume, Buhler Flour, High	2840	2800
Loaf Volume, Buhler Flour, Average	2585	2502
Loaf Volume, Buhler, Specific (Loaf Vol./% Protein)	199.46	205.59

From the above we can conclude:

1. The "quality" of the 1961 samples is superior to that of previous crops, at the time of testing, as evidenced by higher specific Sedimentation and by higher specific Loaf Volume. In other words, with equal protein quantity, Sedimentation and Loaf Volume are higher, indicating better gluten quality in the 1961 crop samples.
2. A definite "milling factor" affecting Sedimentation Test results is evidenced by the significantly higher sedimentation values on the Buhler milled flours versus the "Tag" milled flours on the identical sample of wheat.
3. The results emphasize the necessity of strict adherence to a set milling procedure when running Sedimentation Tests. Variable milling methods cause variable results.

I would like to acknowledge the help of some of my associates in gathering these data: Analysis, Lewis Hotchkiss; Baking, Homer Poe; Buhler Milling, O. A. Noah; Sedimentation, Wayne Fish and Patricia Duffy; Protein, Claude Neill.

JEFF SCHLESINGER
Laboratory Director

Union Equity Co-operative Exchange
Enid, Oklahoma

PURPOSE

The American Association of Cereal Chemists is devoted to: 1) the encouragement of scientific and technical research on cereal grains and their products; 2) the study of development and standardization of analytical methods used in cereal chemistry; 3) the promotion of the spirit of scientific cooperation among all workers in the field of cereal chemistry; 4) the maintenance of high professional standards of its membership; and 5) the encouragement of a general recognition of the value of the chemist and biologist to the cereal industries.

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The Board of Directors is composed of the four officers of the Association plus five directors as follows: John A. Johnson, Kansas State University, Manhattan; Glenn E. Findley, Burrus Mills, Dallas; Lawrence L. Warren, Commander Larabee Milling Co., Kansas City, Mo.; S. F. Brockington, Quaker Oats Co., Barrington, Ill.; Norman E. Lloyd, Clinton Corn Processing Co., Clinton, Iowa.

MEMBERSHIP

Membership in the AACC is open to professionally qualified individuals anywhere in the world. Corporate memberships are available for those companies wishing to lend industry support to the scientific work of the Association. An application form for membership may be obtained by writing the American Association of Cereal Chemists, 1955 University Avenue, St. Paul 4, Minnesota.

FEATURES

COVER: Wheat being combined near Amarillo, Texas, with the use of nine machines. Photo courtesy Deere & Co., Moline, Ill.

CEREAL SCIENCE *today*

OCTOBER 1961 VOLUME 6 NUMBER 8

DEPARTMENTS

CEREAL SCIENCE Today is published ten times per year (monthly except June and August) by the American Association of Cereal Chemists, from 500 South 5th Street, Minneapolis 15, Minnesota. Editorial, Circulation and Advertising Headquarters: 1955 University Avenue, St. Paul 4, Minnesota. Second class postage paid at Minneapolis, Minnesota.

Subscription rates: 1 year, $5.00; 2 years, $8.00; 3 years, $11.00. Foreign postage: $1.00 per year extra. Back issues available on request. Single copies: 60 cents.

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STAFF

editorial

With 1300 members, the American Association of Cereal Chemists can hardly be thought of as a large organization. Indeed, one of its attractions is that it is possible for a member to become personally acquainted with a large portion of the membership. Anyone outside the field might assume that such a group is so specialized that the individuals within it all have very nearly the same professional interests and hold similar jobs. Nothing could be further from the truth.

Several individuals may qualify as working in the field of cereal chemistry and yet their knowledge and activities may be largely mutually exclusive. Consider some of the activities in which cereal chemists are engaged: breeding better baking quality into new wheat varieties; accomplishing more efficient milling separations; finding new industrial applications for the products of corn starch modification or hydrolysis; investigating the physical properties of cereal proteins; controlling the quality of dried milk to be used by bakers; devising more efficient formulations for poultry feeds; helping to improve public health through better human nutrition. Many more could be listed. Some individuals are in work that requires wide general knowledge; others devote their efforts to learning more and more about less and less.

AACC members belong to a parent organization and to a local section. Membership in the latter depends upon geographical location. Some other societies have in addition to these two types of organization a series of divisions according to members' specialized fields of interest. A member may elect to be active in as many or as few of these as he desires. He may shift his divisional affiliations as his work or interests change. Divisional groups are responsible for organizing the several segments of the technical program at national meetings.

With divisions named according to specific scope of interest, it becomes possible for an organization to better define the boundaries of its field. Shifts in divisional affiliation can serve to call attention to changing emphasis within a field. Such a form of organization provides more opportunities for individual member participation and encourages new members to take part in association activities.

The officers and members of the AACC should decide whether the Association has arrived at a point where a divisional organization would provide impetus toward the professional advancement of the organization and its individual members.

P.E.R.

to increase efficiency, save time and effort, follow these pointers on

Baking Laboratory Layout and Procedures

By R. H. Kilborn and T. R. Aitken

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In any laboratory engaged in a heavy program of test baking it is essential that all operations be completed with maximum efficiency and minimum time and effort. These considerations largely determined the layout and procedures of the routine baking section of the Grain Research Laboratory. Close attention has been given to placement of equipment, design of operations to facilitate the flow of work through the laboratory, and use of automatic timers, temperature controls, and other devices that minimize manual operation. Card systems have been developed that eliminate work sheets and minimize time required for records and general paper work.

The routine baking laboratory occupies a floor space approximately 21 feet square. About half of this area is used for physical dough testing, flour moisture determinations, and weighing-up of samples and baking ingredients; the other half is confined to baking operations and bread scoring. Figure 1 is a perspective drawing of the laboratory. The essential equipment is arranged around a 7-ft. square in such a manner that passageways are left where necessary, and all pieces of equipment may be used with a minimum of steps by the baker. An air-conditioning unit maintains room temperature at 78°F.

Mixing Bench

An 8-ft. bench (Fig. 2) accommodates two dough mixers, a warming cabinet, and a water bath for maintaining the temperature of yeast suspension, sugar-salt solution, and water used in making up doughs. The dough mixer was designed to facilitate the mixing of doughs in various gas atmospheres under negative or positive pressures. It was intended as a research instrument, but the mixing action proved so satisfactory that two additional units were constructed in the laboratory for the routine section. The mixer will handle flour doughs of 100 to 200 g. over a wide consistency range without skipping, or climbing or riding of the dough on the mixer pins; thus the dough is given a uniform and consistent amount of work. This mixer is described in *Cereal Chemistry* (2).

Warming Cabinet and Water Bath

The warming cabinet is temperature-controlled at 86°F., and weighed samples of flour for baking (in covered tins), the sugar-salt solution, and the water for the yeast suspension are kept there overnight. The following morning the sugar and salt solution and a freshly prepared yeast suspension are placed in a temperature-controlled bath which has separate compartments for each. The yeast suspension is stirred continuously by a small motor fastened to the lid of one of the compartments. A Lux Ultra Thermostat circulating bath, which is located in a cupboard below the counter, pumps temperature-controlled water through the jackets of the mixing bowls. This bath is automatically switched on, by means of a Tork clock timer, in ample time before dough mixing begins, and is switched off at the end of the mixing schedule. A holding device incorporated in the timer prevents the bath from operating during the weekend. A pushbutton-start, automatic-reset Cycle-Flex timer supplies power to either mixer for a predetermined time interval.

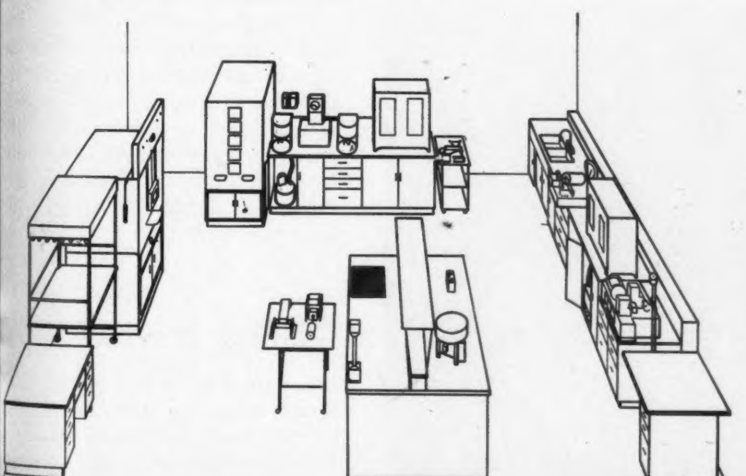


Fig. 1. Perspective drawing showing layout of the routine baking and dough-testing laboratory.

Fermentation Cabinet

The fermentation and proofing

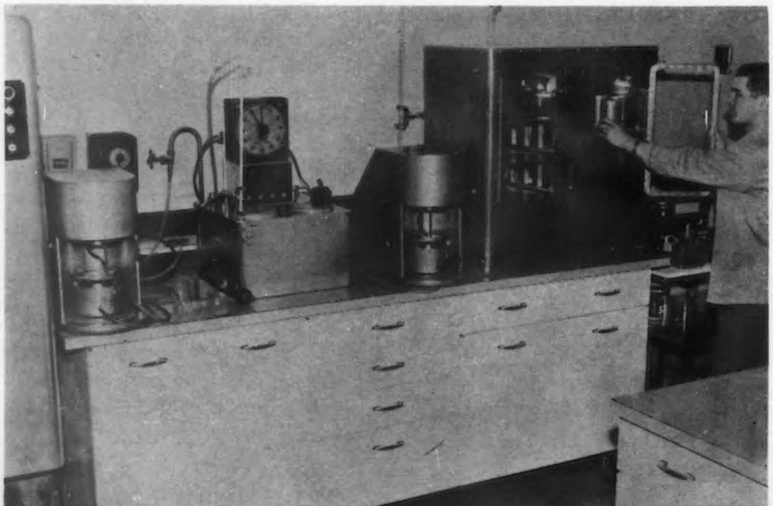
cabinet for 100-g. flour doughs (3) is located next to the mixing bench and occupies a 3-ft. square of floor space. The air is conditioned (90% r.h.) in the bottom of the cabinet, and is blown upward around and through the shelves, which rotate horizontally, thus assuring uniform air distribution. The cabinet is made almost entirely of aluminum and is rustproof throughout. A time switch assembly, located beneath the cabinet, automatically provides intermittent operation of the various electrical circuits to produce the following conditions: early morning cabinet warmup; controlled temperature and humidity throughout the time required for fermentation and proofing; a drying-out period at the end of the day; and switch-off power to cabinet overnight and during weekends.

Fig. 3. Fermentation cabinet (center), oven (left), dough moulder and sheeting rolls (foreground).

Baking Oven

The baking oven is at right angles to and about 3 ft. from the fermentation cabinet (Fig. 3). It is our own design and requires about the same amount of floor space as the fermentation cabinet. The oven shell is cube shaped, made of steel, and lined with rock wool and refractory cement. A squat drum, 12 in. high and 23 in. in diameter, forms the baking chamber and houses a rotating hearth which is divided equally into five compartments by vertical partitions of sheet metal. One motor, mounted below the oven, is used to rotate the hearth by means of a gear reduction unit and clutch assembly, and drives a centrifugal blower. Air is thereby circulated over the baking chamber, from top to bottom, and into a duct that returns the air to the top of the oven. The hearth may be stopped in each of the five positions corresponding to the five compartments and automatically centers before the door opening. Oven moisture loss is therefore minimized, as only one-fifth of the baking chamber is exposed when the door is open. A long-stemmed mercury thermoregulator, mounted on top of the oven and extending into the baking chamber, controls temperature at 435° ± 3°F. by operating fin strip elements located above and below the baking chamber. This type of heater has an enclosed element which minimizes the formation of formaldehyde in the oven which occurs with open elements (1). Furthermore, the fin feature, together with forced air circulation, has a low heat-lag characteristic, which gives a closely controlled oven temperature.

Fig. 2. Dough mixers and timers, water bath for salt-sugar solution and yeast suspension, and cabinet for flour samples.



The required oven moisture level is reached by inserting five oven-conditioning doughs, at regular intervals, ahead of the first test loaf, and is maintained towards the end of the bake by following the last test loaf with four more doughs to provide full oven-load conditions. An aluminum shelf, attached to the front of the oven below the door, facilitates transferring loaves to and from the oven.

Moulder

One of the greatest obstacles to a heavy program of test baking is the dough-moulding operation. Up until two years ago, hand moulding by an experienced baker was used in the Grain Research Laboratory because this method gave greater

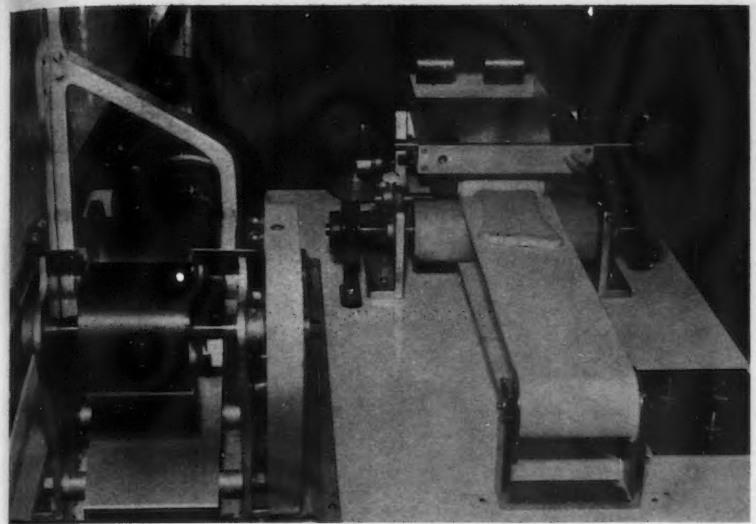


Fig. 4. Dough moulder (right) with sheeted dough going to roll assembly.

differentiation between samples for loaf volume and other loaf characteristics than did commercially available mechanical moulders. It was further demonstrated that moulding had to be carried out by one baker if results were to be truly comparable. About 3 years ago it became clear that the volume of test baking, that must be kept comparable, was increasing and would soon exceed the capacity of one baker. Work was subsequently begun to develop a mechanical moulder capable of handling the wide range of doughs encountered in the laboratory and, at the same time, giving the differentiation between samples similar to that obtained with hand moulding. Parts of a laboratory moulder were used where possible to expedite construction. Figure 4 shows the finished moulder which is mounted alongside a set of sheeting rolls. A sheeted dough piece is fed into the moulder by means of an endless belt and is rolled up and shaped under constant pressure for 30 seconds. The top roller automatically adjusts to the bulk of the dough piece, and a push-button automatic-reset timer assures a constant moulding time. The moulder produces a well-shaped dough with a good seal and smooth surface.

Fig. 5. Bread scoring table.

Bread Scoring Table

The scoring of bread is carried out in the Grain Research Laboratory by experienced laboratory bakers, and visual appraisals are reported for loaf appearance, crumb texture, and crumb color. A specially designed illuminated table (Fig. 5) is used for this purpose. It consists of a battery of fourteen 40-watt fluorescent lamps 4 ft. long, alternate Daylight Blue and Standard Cool White, placed close together and held 38 in. above the work table by an angle-iron framework. The table is on wheels and can be moved about the laboratory. This is an advantage, as crumb texture can be judged more efficiently in the shade of normal room lighting, for which the special lighting is not required. With the table lights switched off and the table positioned, the housing for the fluorescent lamps is large enough to mask the room lighting.

Figure 6 shows a work card, about the size of an IBM card, that accompanies each flour sample included in a day's baking from the time the flour is weighed until the loaf is measured for volume and scored. These cards take the place of notebooks or other work sheets and, in addition to providing a permanent record, can readily be assembled and shuffled for setting up tables for report writing. The left-hand column shows the weight of the flour equivalent to 100 g. on 14% moisture basis and the amount of additional water to provide the proper absorption (predetermined in the farinograph) when the dough is mixed. Another column shows the code letters for the baking methods used, and there is also space for notes on dough-handling properties, loaf volume, and other bread scores. For duplicate baking on another day, a card of different color distinguishes the second bake from the first.

Sample No. 8+90	1960 Date	Meth.	Order	Handling Properties	Loaf Volume	Crust Color	Appear.	Crumb Text.	Form L-40 Crumb Color
Flour Wt. (50.0) 100.0	Oct 14	R	1	L Ex Sp	880	S	10.0	6.50	7.5
Dough Water 12.4 (60.0%)	|	RB	6	SL VEx Sl	660	MP	6.0	5.5	5.5y
Blend Dough Water 7.2 (53.8%)	|	Rx	11	L Ex Sl Sp	705	S	6.0	4.5	5.0yd
	|	A	16	L. Ex Sp	830	S	7.0	8.0	5.5y

Fig. 6. Work card that accompanies flour sample from weighing to loaf measuring and scoring.

Fig. 7. Farinograph with timing device (foreground) for standardizing damping action.

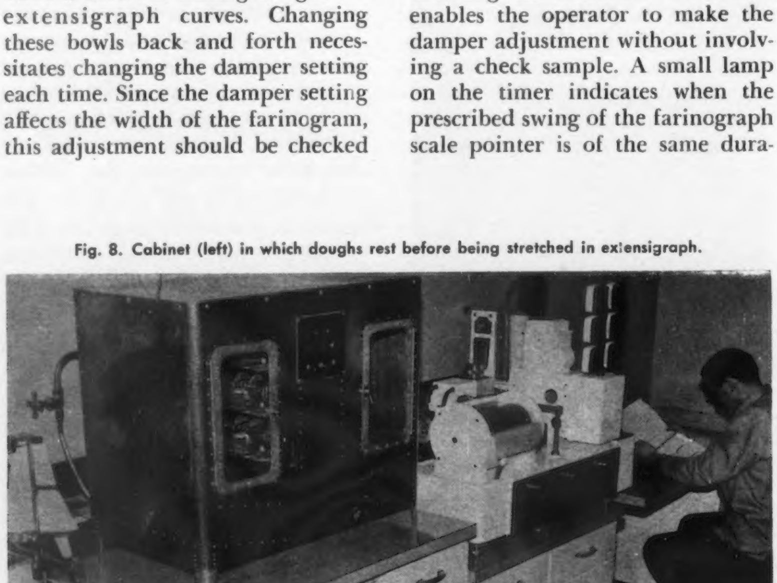
Dough Testing Equipment

The Brabender Farinograph and Extensigraph are the principal physical dough testing machines used in the routine section of the Grain Research Laboratory. The 50-g. farinograph bowl is used for determining absorption and mixing characteristics, and the 300-g. bowl is used for mixing doughs for extensigraph curves. Changing these bowls back and forth necessitates changing the damper setting each time. Since the damper setting affects the width of the farinogram, this adjustment should be checked by using a flour of known curve dimensions. If frequent bowl changes are required, the time required for checking becomes quite significant and interferes with the baking program for which farinograph absorption is needed before samples can be baked. This difficulty has been overcome by constructing an electronic timer that enables the operator to make the damper adjustment without involving a check sample. A small lamp on the timer indicates when the prescribed swing of the farinograph scale pointer is of the same duration as the internal standard timing cycle of the timer. This procedure is much more accurate and reproducible than the stopwatch method. The timer is calibrated, and the timing cycle can be varied from 0.60 seconds to 0.90 seconds ± 0.01 second. A timing cycle of 0.72 second is used for all testing in the routine section, which corresponds exactly with a pointer travel from 1,000 to 100 Brabender units. To accomplish this, the timer connects with two normally closed micro switches on the farinograph; one switch opens at the 1,000-unit mark and the other opens when the pointer passes the 100-unit mark. A 5% voltage fluctuation from a normal of 115 volts has no effect on the time cycle, and a drop of as much as 10% causes a variation of only 0.05 second. The electronic timer is shown at the right of the farinograph in Fig. 7.

The cabinet at the left of the extensigraph (Fig. 8) was designed by the Laboratory to provide a separate unit in which doughs rest before they are stretched to make extensigrams. Temperature and humidity are controlled much more closely than in the space provided for this purpose in the extensigraph. There is room for twelve single dough-holders instead of the usual three double units—an advantage when many samples require testing. This results in improved curve reproducibility. The large doors allow for easy transfer of doughs as required, and the proximity of the cabinet to the extensigraph makes for efficient operation of the test.

The mixograph is used by the Laboratory principally for large series of samples for which mixograms provide the main data required; for example, in years of wet harvests when comparisons are made between corresponding samples (before and after drying) from terminal and farm dryers. In such years the mixograph is in operation daily for several months, and it has been found advantageous to use a method which does away with reproducing curves on standard mixograph paper, which is cumbersome to refer to and awkward to file. This method puts the curve on the IBM card that contains the pertinent information about the sample

Fig. 8. Cabinet (left) in which doughs rest before being stretched in extensigraph.



being tested (Fig. 9). Before the curve is drawn, the card is clipped to a small plastic sheet which has holes punched at top and bottom corresponding in size and spacing to the holes in the mixograph paper. A tip from a ballpoint pen inserted into a brass holder replaces the ink stylus that is standard on many mixographs. After a test, the card can be quickly separated from the plastic sheet and another card put in its place. Figure 10 shows the modified mixograph technique in operation.

Fig. 10. Mixogram being drawn on IBM card containing pertinent information on sample.

In Conclusion

Many of the points of layout illustrated, such as proximity of sink to the farinograph and the mixograph, and the placement of baking equipment to minimize steps between operations, are simply "commonsense" arrangements. But things that are obvious cannot always be done, because of limitations in space or because budgets will not allow for installing new equipment. Chemists who contemplate installing baking equipment for the first time, or who are considering modernizing their existing baking laboratory, should give serious thought to automatic temperature-control and timing devices, mechanization where possible, and an operational system that facilitates a smooth procedural flow with minimum paper work.

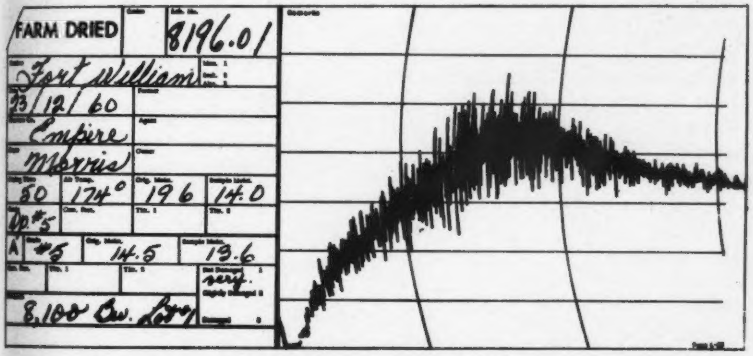


Fig. 9. Mixogram drawn on IBM card.

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3. RASMUSSEN, H. E., and ANDERSON, J. A. *Cereal Chem. 25:* 337 (1948).

INVITATION FOR PAPERS TO BE PRESENTED AT THE 47th ANNUAL MEETING, ST. LOUIS, MAY 20-24, 1962

Members of the AACC are invited to present original scientific papers at the 47th Annual Meeting. The broad scope of the program is now firming up, and you should contact any of the Session Chairmen listed below if you think that you will have a paper to present.

Fats and Oils: Mr. John B. Woerfel, Armour & Co., Box 9222, Chicago 90, Ill.

Feed: Mr. Waldon H. Hastings, Dept. of Flour and Feed Milling Industries, Kansas State Univ., Manhattan

Flour: Miss Doris Baker, USDA, AMS, Agr. Research Center, Beltsville, Md.

Food Additives: Dr. Virdell E. Munsey, Food & Drug Administration, 12th and C Sts. SW, Washington 25, D.C.

Milk Powder and Proteins: Mr. Charles A. Becker, Sheffield Chemical Co., Norwich, N.Y.

Practical Lab Techniques: Mr. Robert B. Kilborn, The Wheatena Corp., Highspire, Pa.

Pre-Milling Treatment of Wheat: Mr. Paul J. Mattern, Dept. of Agronomy, Coll. of Agr., Lincoln 3, Nebr.

Applications and Properties of Soybean Products: Mr. Dale W. Johnson, 1825 N. Laramie Ave., Chicago 39, Ill.

Starch: Dr. Thomas J. Schoch, Corn Products Co., Box 345, Argo, Ill.

Wheat Proteins: Dr. Walter Bushuk, 190 Grain Exchange Bldg., Winnipeg 2, Manitoba

Yeast and Baking: Dr. R. D. Seeley, Anheuser-Busch, Inc., 721 Pestalozzi St., St. Louis 18, Mo.

KENTON L. HARRIS
General Chairman,
Program Committee

how high moisture
and spontaneous
heating affect

Spoilage Control in Mixed Feeds

By L. R. Richardson and B. D. Webb
Texas A&M College
College Station, Texas

THE IMPORTANT ROLE of molds in heating and the accompanying deterioration of grain in storage has been recognized for a long time. Losses are usually more extensive in corn and wheat. A conservative estimate (8) has been made that 1% of the world's grain supply is destroyed annually by molds. On this basis the loss of cereal grains and grain by-products in the United States is estimated to be 30 to 50 million dollars annually. It is difficult to estimate the value of the damage in feeds, but the total amount would be large.

Mold spores are normally present on or in all grains, feed ingredients, or mixed feeds, and there is no practical way of removing them. Under storage conditions which permit germination of spores and growth, respiration of the molds produces heating and deterioration of material. To prevent this deterioration it is necessary to maintain conditions which will not support germination and growth of molds. Many investigators have shown that the amount of available moisture or the relative humidity of the interparticle air is the most important condition that determines the growth of microorganisms on stored grain.

Most feed materials normally have an interspace relative humidity of less than 85%, and the microflora which have humidity requirements of less than this amount are primarily responsible for initiating spoilage in feeds. Bacteria are not important in initiating deterioration, because their humidity requirement is in the range of 90 to 100%, which is usually higher than that in most feed materials. Molds isolated from feedstuffs by Snow (14) which had humidity requirements of less than 85% were identified as belonging to certain members of *Aspergillus* and *Penicillium* species. Species of molds (8) generally found on cereals throughout the world are *Alternaria, Aspergillus, Cladosporium, Fusarium, Penicillium, Rhizopus,* and *Verticillium.* Those species identified on corn at the Texas Station by Webb *et al.* (20) were: *Alternaria* sp., *Aspergillus flavus, Aspergillus niger, Aspergillus terreus, Hormodendrum* sp., *Penicillium* sp., *Rhizopus nigricans,* and *Verticillium* sp.

Snow, Crichton, and Wright (15, 16) and Waite (17) have reported safe moisture conditions for the storage of a few feed ingredients at temperatures ranging from 60° to 70°F. More extensive studies on conditions for the safe storage of feed materials have been carried out at the Texas Station than at any other laboratory, but many of the basic ideas as well as the procedures used in these investigations have been reported previously by other investigators. These earlier reports have been summarized in several recent reviews (1,3, 4,9,10).

This report is a summary of investigations which have been carried out during the past few years on: 1) conditions for safe storage of feeds, 2) effect of high-moisture ingredients on spontaneous heating in mixed feeds, and 3) methods of preventing spontaneous heating in feed materials.

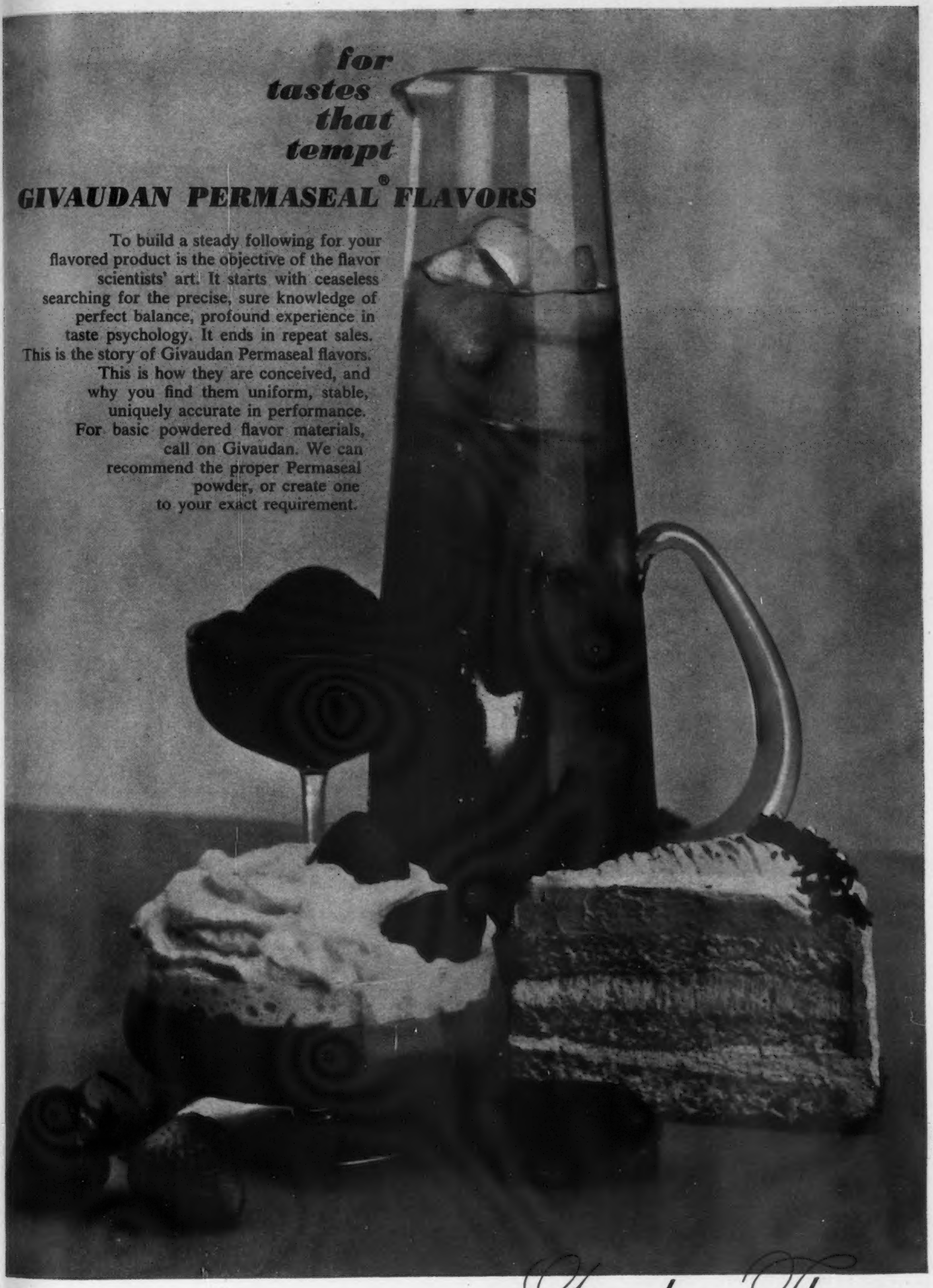
Conditions for Safe Storage of Feeds

Halick, Richardson, and Cline (6) have reported the critical moisture level of about 30 feed ingredients stored at a relative humidity of approximately 70% and a temperature of 32°C. These data showed that the moisture content at which an ingredient heated under these conditions depended on the specific material more than any other factor.

Examples of the variations in the critical level of different ingredients are given in Table I. The level ranged from 8.7% for bone meal to 17.0% for distiller's dried grains and was higher for whole corn, oats, and wheat than for the ground grains. One lot of 50% protein soybean oil meal had a critical level of 15.4%, while two lots of 44% protein had critical levels of 13.1 and 13.8% respectively. Cottonseed meals had a lower critical level than soybean meals.

Table. I. Examples of Variations in Critical Moisture Levels of Different Feed Ingredients Stored at 32°C. and 70% Relative Humidity

Ingredient		*Critical Moisture Level* %
Bone meal		8.7
Corn	Whole	14.7
	Ground	13.0
Oats	Whole	14.5
	Ground	12.3
Wheat	Whole	14.3
	Ground	12.0
Alfalfa meal	Stem	15.1
	Leaf	14.9
Soybean meal	44%	13.8
	44%	13.1
	50%	15.4
Cottonseed meal	Screw press	11.5
	Prepress solvent	12.8
Distiller's dried grain		17.0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tastes
that
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Interspace Relative Humidity

When studies on conditions safe for storage of mixed feeds were started, it soon became evident that safe conditions could not be predicted from moisture content. Heating depended on the moisture content and the concentration of each ingredient present in the mixture. The ingredient or ingredients present in the largest amount usually had more influence than those present in smaller amounts. When a relatively large amount of a nonhygroscopic ingredient such as animal feeding fat was present, total moisture was especially unreliable for predicting safe storage conditions.

In view of the finding in other laboratories that interspace relative humidity largely determines whether molds grow on stored grains, humidity was investigated as a means for measuring safe conditions for the storage of feed materials and mixed feeds. Relative humidities ranging from 40 to 90% were determined on several feed ingredients at 10°, 21°, and 32°C. These humidities were correlated with heating at 32°C. and with the visible evidence of mold growth at 10° and 21°C. The experimental period was 6 weeks. The equipment used for humidity measurement was essentially the same as that described by Brockington *et al.* (2) and by Hubbard *et al.* (7). The procedure for determining the humidity of feeds has been described by Webb *et al.* (18). The relative humidities and heating or the appearance of molds on soybean oil meal containing 13.0 to 20.6% moisture and stored at constant temperatures of 10°, 21°, and 32°C. are summarized in Table II.

Mold growth did not appear on the soybean oil meal containing 15.3% moisture in 42 days when it was stored at 21°C. or less, but when stored at 32°C., heating started in 21 days. Soybean oil meal containing 14.4% moisture and stored at 32°C. started to heat in 28 days. Visible mold growth or heating did not occur in any instance when the interspace storage relative humidity was below 72.5%. These observations (18) were true also of other ingredients and mixed feeds. For safe storage over longer periods this relative humidity should probably be less than 65% when measured at the maximum temperature which the feed will encounter during storage (15,17).

Table II. Relative Humidities and Appearance of Molds on Soybean Oil Meal Containing Different Amounts of Moisture at 10°, 21°, and 32°C.

	10°C.		21°C.		32°C.	
Moisture	Molds[a]	R.H.	Molds[a]	R.H.	32°C., R.H.	Heated
%	%		%		%	days
13.0	61.0	—	63.9	—	70.0	
14.0	63.8	—	66.7	—	73.1	
14.4	65.9	—	69.5	—	74.2	28
14.9	66.6	—	70.0	—	75.9	29
15.3	67.0	—	70.8	—	76.4	21
16.8	69.1	—	73.0	+	78.5	13
17.7	69.7	—	73.9	+	80.1	11
18.6	70.3	—	75.4	+	81.5	9
20.6	72.5	+	75.7	+	83.5	9

[a] Observations at 42 days. +, molds present; —, no mold growth.

High-Moisture Ingredients

Feeds containing high-moisture ingredients such as feeding cane molasses (6), fish solubles, or condensed fermented corn extractives (19) are more susceptible to heating than those containing normal solid ingredients. Feeding cane molasses normally contains from 25 to 28% moisture, whereas fish solubles and condensed fermented corn extractives contain from 45 to 55% moisture. The effect of these ingredients on heating is due to their water content rather than to the other substances present.

Degrees Brix and total sugar content expressed as invert sugar are used in the definition of feeding cane molasses by the Association of American Feed Control Officials. Efforts have been made by this Association to include moisture content in the definition, but so far their recommendation has not been adopted. Correlation between Brix and moisture content is very low, and Richardson (11) has recommended that moisture content instead of Brix be used in a standard for feeding cane molasses. Two major objections have been raised to adopting a moisture standard. One is that the time required to determine moisture is too long for it to be practical in the feed industry. The other objection is that moisture values have not always been reproducible in different laboratories, and frequently they have not been reproducible in the same laboratory.

Two series of tests have been run recently in order to compare the variation in moisture and Brix values obtained from the same lot of molasses, collected at different times and after the samples had been stored under different conditions. In one test, five samples were taken from each of fifteen different tank truckloads of molasses at different times. A description

Table III. Effect of Storage Temperature on Degrees Brix and Moisture Contents of Molasses Containing Different Amounts of Moisture

	Percent Moisture				Degrees Brix			
Lot	Initial	Stored 18 Weeks		Max. Change	Initial	Stored 18 Weeks		Max. Change
		6°C.	37°C.	%		6°C.	37°C.	%
Series I								
A	22.3	22.4	22.3	0.1	85.7	85.4	85.0	0.7
B	23.4	23.5	23.3	0.2	84.4	84.9	84.8	0.5
C	23.3	23.2	23.6	0.4	83.3	83.3	82.7	0.6
D	23.0	23.3	23.3	0.3	84.0	83.9	84.1	0.2
Series II								
A	25.2	25.3	25.3	0.1	82.4	82.3	81.5	0.9
B	25.3	25.3	25.1	0.2	82.8	82.8	83.1	0.3
C	25.6	25.5	26.2	0.7	81.6	81.0	79.9	1.7
D	24.9	25.1	25.1	0.2	82.1	82.0	81.3	0.8
Series III								
A	26.3	26.4	26.4	0.1	80.5	80.2	79.9	0.6
B	26.4	26.4	26.5	0.1	81.3	81.2	80.1	1.2
C	26.6	26.9	27.4	0.8	79.3	79.2	78.1	1.2
D	26.0	25.9	26.1	0.2	80.2	80.6	80.3	0.4
Series IV								
A	28.4	28.7	29.6	1.2	78.4	78.3	76.2	2.2
B	28.2	28.7	28.7	0.5	78.8	79.0	78.0	1.0
C	29.2	29.4	30.4	1.2	76.8	76.8	75.9	0.9
D	28.0	28.1	27.5	0.6	78.6	78.3	78.4	0.3

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of the samples and data for Brix and moisture have been described previously (12). The data showed that the values for moisture as well as for Brix of different samples from the same lot of molasses agreed very closely when the analyses were run immediately after the samples were collected. The samples were then stored in closed glass jars at ambient temperature for 2 months and the analyses were repeated. At this time practically every sample had a higher moisture and lower Brix. The changes were not entirely consistent from sample to sample, but they were greater in molasses with high moisture than in samples with low moisture.

A second test was run with one sample collected from each of four different distributors. The original sample in each case had a Brix ranging from 84° to 87° and moisture content ranging from 19 to 22%. All of the four original samples were diluted, to contain approximately 23, 25, 26, and 28% moisture. After moisture, Brix, and total reducing sugar had been determined, each of the diluted samples was divided into two portions and sealed in quart Mason jars. One portion was stored in a cold room at 6°C. and the other was stored in a constant temperature incubator room at 37°C. Analyses were repeated on all samples at 8 weeks for moisture and Brix, and again at 18 weeks for moisture, Brix, and sugars. The data for initial values of moisture and Brix and after storage for 18 weeks are summarized in Table III.

The data show that moisture values were reproducible within 0.3% on all samples diluted to contain approximately 23 and 25% moisture, even after they had been stored for 18 weeks at 6°C. The maximum difference in moisture of the same samples stored at 37°C. was 0.7%. Samples (Series IIC, IIIC, IVC) from one lot of molasses which had been diluted to contain 25.6%, 26.4%, and 28.2% increased in moisture 0.7%, 0.8%, and 1.2% respectively after storage for 18 weeks. Another lot (Series IVA), which had been diluted to contain 28.4% moisture, increased 1.2%. Four of twelve samples containing more than 25% moisture increased in moisture when they were stored for 18 weeks at 37°C. Samples representing two original lots and diluted to contain 28.4 and 29.2% initial moisture, respectively, increased 1.2% in moisture during storage. A third lot (Series IVB), diluted to contain 28.2% moisture, increased 0.5%; a fourth lot (Series IVD), which was collected at the refinery and obviously was a high-quality molasses, changed very little when stored for the same period and under the same conditions.

The data in Table III show that molasses stored for 18 weeks may decrease in Brix and increase in moisture. These changes are greater in samples stored at 37°C. than in those stored at 6°C. Furthermore, the decrease in Brix was accompanied by a corresponding increase in moisture and, in general, both of the changes were accompanied by a decrease in total invert sugar. Simultaneous changes of this nature would be expected if the sugars decomposed during storage. Additional evidence that decomposition actually occurred was the observation that foaming was extensive in two samples (Series IV, A and C) that contained 28.4 and 29.2% moisture respectively before they were stored. Lot C (Series III) that contained 26.6% initial moisture, also foamed extensively during the storage period. It is concluded that differences in practically every instance represent changes in composition rather than error in the analyses. These changes may occur in some lots of molasses and not in other lots, but in order to reduce them to a minimum in all molasses, the moisture content should not be over 26% and a maximum of 25% would be preferable. Furthermore, whenever the analyses may have to be repeated for control purposes, samples containing more than 23% moisture should be stored under refrigeration.

Table IV. Effect of Pelleting on Spontaneous Heating in Mixed Feeds

	Moisture Content			
		After Pelleting and Cooling		
Feed No.[a]	*Before Pelleting*	*Trays Exposed to Air*[b]	*Closed Containers*	*Heated*
	%	%	%	*days*
A	15.1	11.1	15.0	11
B	15.9	11.8	15.9	10
C	16.4	11.6	17.0	9

[a] The basal mixtures contained: ground corn, 69.0%; soybean oil meal, 25.0%; steamed bone meal, 3.0%; alfalfa leaf meal, 2.5%; and salt, 0.5%; 2.5% condensed fermented corn extractives were added to the basal mixture.

[b] Pellets treated in this manner did not heat.

Prevention of Spontaneous Heating in Feeds

To prevent the growth of molds and the accompanying spontaneous heating, it is necessary to maintain conditions which do not permit mold spores to germinate and grow. The most important conditions in controlling the growth of molds are temperature, moisture, and supply of oxygen and nutrients.

Practically all feeds will supply adequate nutrients, and under normal storage conditions ample oxygen is available. Temperature will be essentially the same as the local atmospheric temperature where the feed is stored and may be constant for only short periods. Thus, moisture content is the most important factor that can be controlled under conditions occurring most frequently in the storage of feed materials. Moisture conditions must be maintained so that molds cannot germinate and grow, and these conditions must be determined at the maximum temperature the feed will encounter during storage. An interspace relative humidity of less than 70% at 32°C. should be safe for 3 to 6 months in most areas of Texas. It should be safe for longer periods in cooler climates, but for storage over a year or more, an interspace relative humidity of 65% at 32°C. would be preferable.

Pelleting to Prevent Spontaneous Heating

Since most feeds containing high-moisture ingredients are highly susceptible to heating, a test was run to determine whether pelleting could be used to control heating in these mixtures. In this test, mixtures containing 15.1, 15.9, and 16.4% moisture were pelleted. One lot of each mixture after pelleting was allowed to cool, in shallow trays exposed to normal air currents in the laboratory. The other lot was allowed to cool in closed

Table V. Effect of pH of the High-Moisture Ingredient on the Amount of Sodium Propionate Required to Prevent Heating in Mixtures

Series and Ingredients	Propionate Added, Percent of Mixture	Moisture Content of Mixture	Days Required to Start Heating	
			pH 5.1	pH 3.0
	%	%		
A: Ground corn 90%, cane molasses 10%	none	16.0	5	8
	0.075	16.0	15	27
	0.100	16.0	20	[a]
	0.125	16.0	[a]	[a]
B: Ground corn 95%, fish solubles 5%	none	17.5	14	19
	0.075	17.5	22	[a]
	0.100	17.5	28	[a]
	0.125	17.5	35	[a]
C: Basal feed mixture[b] 97.5%, condensed fermented corn extractives 2.5%	none	14.0	14	11
	0.050	14.0	20	24
	0.075	14.0	29	35
	0.100	14.0	35	[a]
	0.125	14.0	[a]	[a]
	0.113	15.3		22
	0.138	15.3		29
	0.150	15.3		[a]
	none	16.5		6
	0.125	16.5		33
	0.150	16.5		[a]

[a] Did not heat during a 6-week storage period at 32° and 70% r.h.
[b] Same as given in footnote 2, Table IV.

containers. The moisture values and days required to heat are summarized in Table IV. When the pellets were cooled in normal air currents, the moisture was decreased to less than 12% regardless of the original moisture content and none of the mixtures heated. However, when the pellets were cooled in closed containers there was essentially no loss in moisture and all mixtures heated in 9 to 11 days. These data indicate that pelleting may be a practical way to make feed safe that otherwise would be highly susceptible to mold growth and heating.

Use of Inhibitors to Prevent Spoilage

Growth of molds on many materials can be prevented by fungicides or fungistatic treatments, but an absolutely effective nontoxic fungicide has not been developed for use in human and animal feeds. Sodium and calcium propionate and sorbic acid are used rather extensively to delay growth of molds on bakery products, cheese, and foods which are packaged for human consumption. It has been reported previously (13) that these compounds, as well as propionic anhydride and propionic, butyric, valeric, and caproic acids, will inhibit the growth of molds in corn meal containing 13.4 to 18.0% moisture. The amount of propionate required was 0.3%, and this level is generally considered uneconomical for use in animal feeds.

Effect of pH on Propionate Inhibition

Wolford (21) showed that sodium propionate was 40 times more effective in inhibiting the growth of *Escherichia coli* at pH 4.5 than at 7.0, and Halick (5) found that calcium propionate was more effective in inhibiting the growth of *Aspergillus niger* at pH 3.1 than at 6.1. In view of these reports, tests were run to determine whether less propionate would be required when it was added to the high-moisture ingredient at an acid pH before it was mixed in the feed. Accordingly, sodium propionate was added to feeding cane molasses, fish solubles, and condensed fermented corn extractives after each had been adjusted to pH 5.1 and 3.0. These high-moisture ingredients containing the propionate were then mixed with ground corn or a basal feed mixture. The results of these tests are summarized in Table V. In every case, less propionate was required to prevent heating when the propionate was added to the high-moisture ingredient at pH 3.0 than when it was added at 5.1. The data in Series C show also that feeds containing 14.0% moisture will require less propionate to prevent heating than those containing 15.3 or 16.5% moisture. Thus it appears that sodium propionate at a level of 0.15% is as effective in preventing mold growth when added to the high-moisture ingredient at pH 3.0 as 0.3% when added directly to the entire mixture containing the same amount of moisture.

Table VI. Amount of Sodium Propionate Required to Prevent Heating in Mixtures of Ground Corn and Cane Molasses or Fish Solubles at Various Humidities

Ingredients and Sample No.	Moisture Content of Mixture	R.H. of Mixture	pH[a]	Propionate Required to Prevent Heating[b]
	%	%		%
Ground corn 90%, cane molasses 10%				
1	15.3	77.5	5.1	0.100
2	16.7	83.4	5.1	0.125
3	20.2	92.0	5.1	0.500
4	21.0	92.0	3.0	0.250
Ground corn 95%, fish solubles 5%				
5	15.9	79.0	5.1	0.100
6	16.2	82.0	5.1	0.125
7	22.0	96.5	5.1	0.500

[a] pH of cane molasses or fish solubles when propionate was added.
[b] These data were obtained at 32°C. and 70% r.h.

The relation of humidity to the amount of propionate required to prevent heating in mixtures containing ground corn and molasses or fish solubles is given in Table VI. When propionate was added to the molasses at pH 5.1, 0.1% of propionate prevented heating at relative humidities below 80%. At humidities above 90%, 0.5% of propionate was required, but at pH 3.0, 0.25% was sufficient. The acidity of the molasses-propionate mixture did not change the pH of the final mixed feed a measurable amount.

Summary

Two methods are described for evaluating critical moisture conditions for the storage of feed ingredients and mixed feeds. Moisture content was used in one method and interparticle-air relative humidity in the other. Moisture content was satisfactory for predicting moisture conditions safe for the storage of individual ingredients, but it was unreliable for mixed feeds. On the other hand, interparticle-air humidity, as measured by an electric hygrometer and humidity-sensing element, was reliable for both ingredients and mixed feeds. Safe moisture contents varied from 8.7% for bone meal to 17.0% for distiller's dried grains, but a safe humidity was constant for either ingredients or mixed feeds. No mold growth or heating occurred during a 6-week storage period when the humidity was 72% or less, provided the humidity was measured at the same temper-

ature as that at which the feed was stored.

Three of four lots of feeding cane molasses containing 26 and 28% moisture increased in moisture and decreased in Brix and total sugar when the samples were stored at 37°C. for 18 weeks. Practically no changes occurred in any of the dilutions when the molasses was stored at 6°C. Similarly, no changes occurred at either storage temperature when the moisture content was 25% or less.

Propionate was more effective as a mold inhibitor when it was added to a high-moisture ingredient, such as cane molasses, at pH 3.0 before it was mixed into the feed than when it was added to a high-moisture ingredient at a neutral or alkaline pH or when it was added directly to the feed mixture.

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bromide residues in
cereal products
resulting from

Experimental Fumigations with Methyl Bromide

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One of the most common analytical methods for determining residues resulting from fumigation with organic bromide fumigants is the total bromide method published in 1942 by Shrader, Beshgetoor, and Stenger (1). This procedure involves hydrolysis, ashing, and finally titration with sodium thiosulfate. Scientists in our Chemical Physics Laboratory have demonstrated that they can carry out some of the analyses for us by measuring the X-ray fluorescence of a sample.

The phenomenon of fluorescence is well known in the visible range of electromagnetic radiation. Light of one wave length is absorbed, and the energy is given up as light of a second wave length, which is usually longer. The same phenomenon is observable in the X-ray range of the electromagnetic radiation spectrum. If X-rays of a given wave length are absorbed by an atom, one mode of giving up the energy absorbed is by the emission of an X-ray of longer wave length. It happens that each element so excited will give off "fluorescent" radiation of a unique wave length. In addition, if the activating energy is held constant, in a given system, the intensity of the radiation given off is proportional to the total quantity of element present which produces X-rays of that particular energy. Thus, by measuring the intensity of radiation of a given energy under standardized conditions, it is possible to determine the relative amount of the element present in the sample. This makes no difference as to the chemical status of the element, since the phenomenon is associated only with the inner electrons of the atom. The analysis for total bromide is carried out by placing the sample in an X-ray beam and measuring the intensity of the fluorescent beam at a specific wave length.

With the passage of the Food Additive Amendment to the Food, Drug and Cosmetic Act, it has become necessary to propose tolerances for bromide residues in many commodities resulting from fumigation with methyl bromide. This fumigant is used so widely, in fact, that nearly everything we eat may at some time have been exposed to it. Because of the wide variety and great number of products which must be considered, a shortcut was desired.

An experiment was set up to determine the relationship of moisture, protein, and fat content of material to the residues of bromide which are accumulated during fumigation. If one of these factors could be related to the residue accumulation, it would be possible to put commodities in categories based on such content, and thereby eliminate a great number of fumigations.

The commodities used for this study were rolled oats, whole corn meal, degerminated corn meal, and macaroni. These were selected because of the differences in content of fat and protein. It was expected that this would show any correlation between the content of one of these constituents and the bromide residue, if any exists. In addition to fumigations at normal moisture content, the moisture of rolled oats and whole corn meal was altered to determine any correlation between water content and bromide residue.

Analytical Procedures

Moisture was determined by subjecting the sample to 100°C., for 5 hours under vacuum.

Fat was determined by measuring the ether-extractable portion in a Soxhlet apparatus.

Nitrogen was determined by conventional macro Kjeldahl procedure.

Total bromide was determined on the samples by the method of Shrader *et al.* (1), and by the X-ray fluorescence method described above.

Procedure

One hundred pounds each of degerminated corn meal and macaroni were obtained from a commercial food source, and 300 lb. of rolled oats. A local feed mill was the supplier of 300 lb. of whole yellow corn meal.

The macaroni was removed from its original small packages and thoroughly mixed before use. This was done by putting it into a large fiber barrel, which was filled to about one-third of its volume. This was rolled on a rolling mill for about 15 minutes.

The other commodities were thoroughly mixed in a commercial feed mixer before sampling and fumigation.

Fumigation was carried out in laboratory vaults consisting of modified 21-liter aluminum food pressure cookers. After loading, the vault is hermetically sealed and a partial vacuum is drawn. The calculated amount of methyl bromide gas, measured in a gas buret, or weighed as chilled liquid into a special dispensing flask, is drawn into the chamber through a valved entry pipe. As soon as the fumigant

Table I. Bromide Residues in Corn Meal Fumigated with Methyl Bromide

	Fat	Nitrogen	Moisture	Methyl Bromide	Bromide Av.[a]	Bromide Av., Dry Basis[a]
	%	%	%	lb/1000 cu ft	ppm	ppm
Whole yellow corn meal	4.49	1.33	11.8	0	0	
				2	25	28
				4	54	61
				6	87	99
			7.1	2	28	30
				4	41	46
				6	66	71
			13.1	2	37	43
				4	46	53
				6	86	99
Degerminated corn meal	2.03	1.27	10.9	0		
				0		
				2	18	20
				4	61	68
				6	89	100

[a] Corrected for untreated blank.

has been admitted, the pipe is opened to the atmosphere and normal pressure is established. The sweep of air serves to mix the gas with the air in the vault. The vaults are then sealed until the end of the exposure period.

In this experiment the fumigations were conducted for 24 hours at about 80°F. The contents were then removed and allowed to aerate at least 24 hours before samples were removed for analysis. Aliquots of the material were removed for analysis as vaults were filled. One third of each of the whole corn meal and rolled oats was partially dried before fumigation, and moisture was added to another third of each. Drying was accomplished by spreading the material in a layer not over 1 in. deep on plastic film in large pans. These were placed in constant-temperature ovens at 60°–80°F., for several hours. After drying, the cereal was stored a few days to allow moisture equilibration. Water was added to the rolled oats and whole corn meal in a feed mixer by means of a fine spray over the surface during mixing. The cereal was allowed to stand 2 or 3 days after the water was added, so it would have a chance to equilibrate. A total of 65 fumigations were carried out.

Results and Discussion

Tables I and II summarize the results of all the analyses. The bromide residues are given as an average of all the results from fumigations under identical conditions. The averages are then calculated to give residue on the dry basis. The data given for composition of the samples are averages of several determinations. In whole yellow corn meal and rolled oats, the moisture content of the first series is that which was found to be naturally occurring. The moisture in degerminated corn meal and macaroni was not altered for the fumigation.

Fumigation was carried out by filling the chamber two-thirds full in most cases. For rolled oats, the load was altered for two fumigations. This was to determine the effect of chamber load on the residue, when the same rate of fumigant was used, based on total chamber volume. It will be noted in Table II that the material fumigated at one-third chamber load picked up approximately twice as much residue as that fumigated at two-thirds or full chamber load. There is not a significant difference between samples taken from the two-thirds full and fully loaded chambers.

Table III compares the rate of bromide residue pick-up for the cereals. Average values are given for the composition. Percentages of fat and Kjeldahl nitrogen are given on the basis of dry weight. To calculate the rate of residue uptake, the average residue at each level of fumigation was divided by the pounds of methyl bromide per 1,000 cu. ft. used. Comparison of

Table II. Bromide Residues in Macaroni and Rolled Oats Fumigated with Methyl Bromide
(Chamber filled two-thirds full for all fumigations except two cases in rolled oats as noted)

	Fat	Nitrogen	Moisture	Methyl Bromide	Bromide Av.[a]	Bromide Av., Dry Basis[a]
	%	%	%	lb/1000 cu ft	ppm	ppm
Macaroni	2.21	2.07	8.3	0	4	4
				2	6	7
				4	7	8
				6	12	13
Rolled oats	8.26	2.43	8.8	0	2	2
				0		
				2		
				2	52	57
				4	122	129
				6	186	204
				2[b]	114	125
				2[c]	47	52
			2.98	2	51	52
				4	132	135
				6	179	183
			9.0	2	48	53
				4	103	113
				6	135	149

[a] Corrected for average untreated blank.
[b] One-third chamber load.
[c] Full chamber load.

the values found for rolled oats and whole corn meal at different moisture content shows that there does not appear to be a correlation between moisture and rate of residue pick-up. The rate does not appear to depend on fat content alone, since degerminated corn meal has a rate of bromide uptake about the same as whole corn meal, although the latter has more than twice as much fat as the former (5.1 to 2.2%). The rate does not appear to depend on nitrogen content as shown by comparison of the values in that column. While oats have the highest nitrogen (2.7%) and the highest rate of uptake (29), macaroni has almost as much nitrogen (2.3%) but has a rate of only one-tenth that of oats (2.25).

There is considerable variability among the replicated analyses from many of the samples. It is not known whether this is due to taking replicate samples which actually contained such varying amounts of residue, or whether the chemical determination was variable because of other reasons, or a combination of these factors. Some variation can be expected between fumigations, even though the same nominal rate is used and the same conditions apply.

Table III. Rate of Bromide Residue Deposition in Four Cereal Products from Fumigation with Methyl Bromide Compared to Dosage and Composition of Product
(Chamber fumigation for 24 hours at 80°F.)

Commodity	*Composition (Dry Basis)*		*Moisture*	*Rate of Bromide Residue Uptake at:*[a]			
	Fat	*Nitrogen*		*2 lb/1,000 cu. ft.*	*4 lb/1,000 cu. ft.*	*6 lb/1,000 cu. ft.*	*Av.*
	%	%	%				
Whole corn meal	5.1	1.5	7.1	14	10	11	12
			11.8	13	14	15	14
			13.3	10	12	15	12
Degerminated corn meal	2.2	1.5	10.9	9	15	15	13
Macaroni	2.4	2.3	8.3	3.0	1.8	2.0	2.3
Rolled oats	9.1	2.7	3.0	26	33	30	30
			8.8	26	31	31	29
			9.0	24	26	23	24

[a] Rate $= \frac{\text{ppm Br}}{\text{lb. MeBr/1000 cu. ft.}}$, calculated on moist basis.

In general, the residue of bromide is proportional to the dosage of fumigant. This has been found to be true in previous experiments with other commodities.

From this experiment it was concluded that no generalizations can be made as to rate of bromide residue uptake, based on moisture, fat, or nitrogen content. However, it is indicated that products originating from the same grain may be expected to accumulate bromide residues at about the same rate under similar conditions of fumigation.

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1. SHRADER, S. A., BESHGETOOR, A. W., and STENGER, V. A. *Ind. Eng. Chem., Anal. Ed. 14:* 1 (1942).

BOOK Reviews

The Molds and Man, by Clyde M. Christensen; 229 pp. University of Minnesota Press, Minneapolis, Minn., Second Edition revised 1961. Paperback price $1.75. Cloth edition $4.75. Reviewed by HOWARD E. BAUMAN, Associate Director of Research, The Pillsbury Co., Minneapolis, Minn.

The author starts out the book by stating "The aim of this book is to give a general account of the fungi and their impact upon us . . ." The reviewer found that the book can be classified as popular reading. It is definitely written in a manner that is understandable to almost anyone regardless of whether he or she has studied fungi. The author has a method of explanation and description in both words and pictures that shows very clearly what he intends to convey.

The book covers in a professional way the role of fungi in relation to plants, animals, food, and its role in nature. The reviewer recommends this book especially to those persons unfamiliar with fungi but who would like to have a better understanding of the subject. Numerous references are cited so that the book can serve as a source of detailed information if desired.

■ ■ ■ ■

Scandinavian Research Guide. Vol. I, xix + 687 pp.: Research Institutes. Vol. II, 486 pp.: Central Research Organizations, Universities and Institutes of Technology, Information Centers, Scientific Societies. Scandinavian Council for Applied Research, Blindern, Norway, 1960. Price $10.00. Reviewed by C. L. BROOKE, Merck & Co., Inc., Rahway, N. J.

This comprehensive and well-arranged work, described as a "Directory of Research Institutions within Technology and Science Exclusive of Life Sciences," is designed for the use of persons engaged in the field of science and technology. It gives concise, detailed, and factual information on more than 1,500 research institutions in Scandinavia, and affords a complete and reliable picture of present-day Scandinavian scientific and technological research.

laboratory HELPS and GADGETS

PHOTOMICROGRAPHY TECHNIQUES

Photomicrography is generally considered an operation involving elaborate and expensive equipment such as special cameras, adapters, sensitive light-measuring devices, and even special microscopes.

This conception is not necessarily true. Quite creditable work can be done with practically any 35-mm. camera and a good microscope, by making use of a few inexpensive articles usually found in the laboratory and equipment of the average camera fan. By experimenting with lighting, exposure time, and backgrounds, it is possible to get results comparable with those obtained through the use of specialized equipment.

Either a monocular or binocular microscope can be used. For the monocular instrument the camera is mounted on a ringstand and adjusted to the eyepiece so that the respective planes of the lenses are parallel. The microscope must be prefocused before the camera is lowered into place for photographing. Most cameras have a recessed lens that allows a closely fitting junction between camera lens and eyepiece. Slipping a rubber sleeve over the rim of the eyepiece ensures the exclusion of any stray light.

The binocular microscope affords a better adaptation for the camera and is more satisfactory for color work. The camera can be mounted on this type of instrument so that one eyepiece can be used to view and focus; the other is used to photograph.

Spread the two eyepiece mounts to the greatest pupillary distance and, with the right eye, focus the instrument on some object using the right-hand eyepiece and a low-power objective. Without changing the focal position adjust the left eyepiece to focus on the object, again using the right eye. This synchronizes the two eyepieces for any change in focus or objective.

The camera can now be mounted on the right-hand eyepiece with the lenses of the camera and eyepiece in parallel planes. Before attempting any exposures it is important to set the camera lens at infinity with the opening at the greatest width; f. 2.8 and f. 3.5 lenses adapt more readily than the faster lenses.

Figure 1 shows the articles used for mounting the camera. Items numbered 1, 2, 3, and 5 are used for the monocular microscope. No. 1 is a rod with standard ¼-in. thread to fit the threaded tap in the camera. No. 2 is a wing nut to lock the camera in position. No. 3 is a standard large universal clamp holder, and No. 5 is a piece of rubber sleeve to fit over the rim of the eyepiece. These are all used as shown in Fig. 2, left.

Items numbered 4, 5, 6, and 7 (Fig. 1) are used for the binocular mount. No. 4 is a microscope lamp arm that has a ¼-in. tap to accommodate a flash attachment arm, No. 7. No. 6 is a small adaptor machined to fit the lamp arm receptacle in the microscope head and to hold one end of the arm, No. 7. This item is not needed if a lamp arm is available for the make of microscope used. Figure 2, right, shows the camera mounted on a binocular microscope.

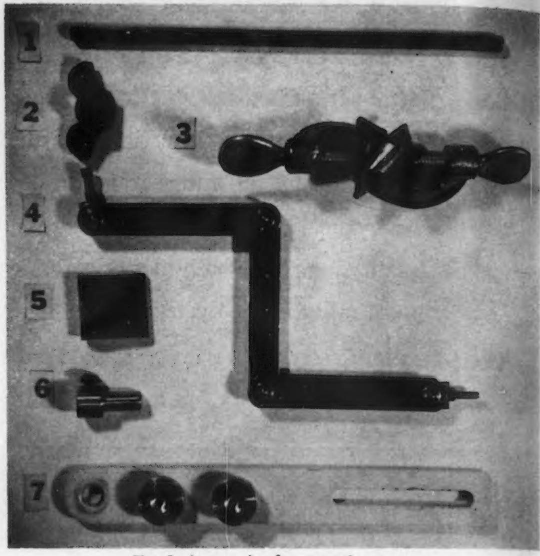


Fig. 1. Accessories for mounting camera.

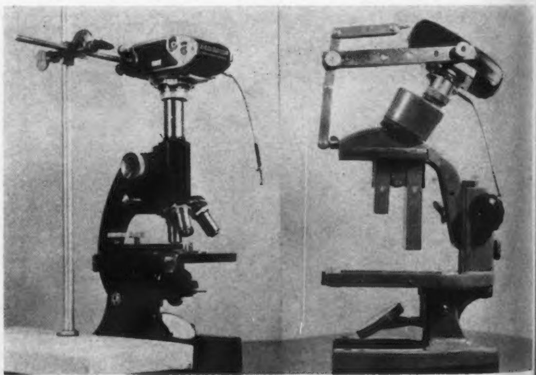


Fig. 2. Left, monocular mount; right, binocular mount.

Exposure time will necessarily vary with the type of film used. As a guide to the beginner, type F Ekta-chrome film used with normal lighting will require about 1 second exposure at 10× with an increase to 2 seconds at 30×. With a little experimental work varying lighting arrangements and exposure time with combinations of objectives and eyepieces, it is possible to obtain some very satisfactory results, and to develop a technique that will prove photomicrography interesting as well as useful.

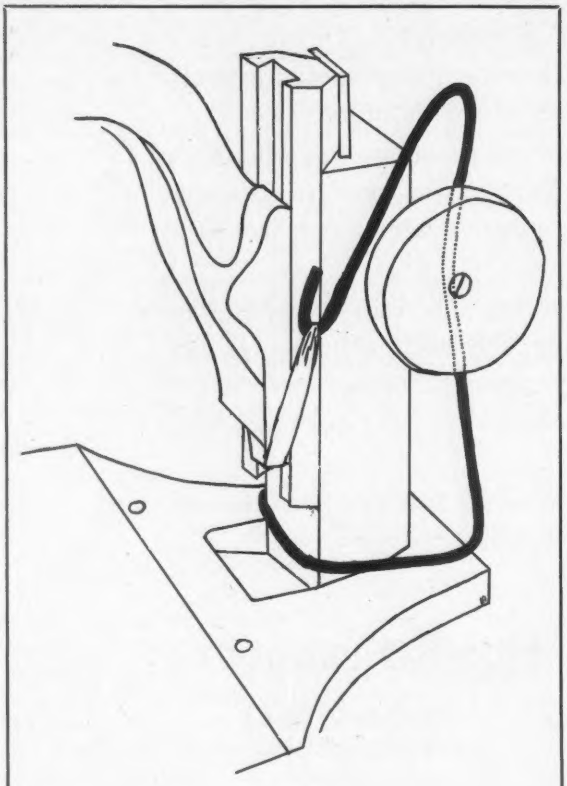
R. E. ANDERSON

Archer-Daniels-Midland Co.
Minneapolis, Minn.

EASY FOCUSING TECHNIQUE

In much of the microscopic analytical work with the widefield microscopes (zb insect-fragment counting) there is a great deal of focusing. Unfortunately, the instruments available for this purpose have made little provision for really easy focusing. Most have a rack-and-pinion focusing arrangement that is held in position by pressure on the brass slides. In other words, to keep the microscope head from coasting down out of focus, the bearing surfaces are screwed together quite tightly, and the focusing knob is rather stiff.

Some of the analysts around the Department's laboratories have, in the past, resorted to makeshift arrangements so that the focus rack and pinion can be loosened and the focusing knob readily turned, at the same time supporting the optical head so that it does not drift down on the specimen.



One such arrangement, which can readily be manufactured out of a piece of stiff wire (a clothes hanger is satisfactory) and a heavy rubber band, is shown in the enclosed drawing

K. L. Harris
Assistant to the Director

Bureau of Biological and Physical Sciences
Food and Drug Administration
Washington 25, D.C.

AACC LOCAL SECTIONS

Kansas City Section met on July 28 at the Prom Motor Hotel. The meeting began with a film showing the complete story of wheat as a domestic industry. Then rough sketches of the crop by area were given by G. W. Schiller, T. R. Warren, Duane Foote, Howard C. Becker, and Marvin Lawrenson.

Highlight of the gathering was a panel discussion on the 1961 wheat crop. Included on the panel were James M. Doty, Doty Technical Labs., North Kansas City; Howard C. Becker, Nebraska Consolidated Mills Co., Omaha; Lester H. Fischer, Rodney Milling Co., Kansas City; John W. Giertz, Kansas Milling Co., Wichita; Lawrence L. Warren, Commander-Larabee Milling, Kansas City; and Marvin Lawrenson, Colorado Mill & Elev., Denver.

• • • •

New York Section, meeting on Sept. 12 at the Brass Rail, heard Dr. Samuel A. Matz, head of the Refrigerated Dough Dept., Borden Foods Co. in Syracuse. His talk, "Texture Deterioration in Frozen Bakery Foods," included a discussion on the effect of the freezing process on the quality of baked and unbaked foods, changes in flavor and appearance, with particular emphasis on texture – the principle area of deterioration.

• • • •

Pacific Northwest Section has tentatively set the dates of June 11-12 for the 1962 meeting in Spokane. The local arrangements committee will be headed by Waldon Chambers, and will include A. J. Shogan, Don Colpitts, Harold Blain, and Frank Nataf. The following chairmen were also appointed: Fred Barrett, membership; Grover Greeves, allied trades; and Don Colpitts, accuracy award. Don Sundberg and Colpitts will represent the Section at the Pacific Northwest Crop Improvement Association.

The Montana winter harvest is almost complete and it will average about 13% protein with good baking quality. It appears the yields of spring wheat will be only fair to poor – 10 to 15 bushels per acre. The spring wheat will be high in protein with test weights averaging 56 to 57 lb. per bushel.

• • • •

Southern California Section held its first meeting of the season on Sept. 5 in Los Angeles' Rodger Young Auditorium. Chemists, representing the local flour mills, took part in a panel discussion on the quality of the 1961 wheat crop. Later Jack La presented his movies of this summer's annual picnic.

• • • •

Tri-Section Meeting convenes on Oct. 27-28 in Manhattan, Kan.

the President's Corner

news of the association

ASSOCIATE MEMBERSHIP

At the AACC's 46th Annual Meeting (April 9-13, Dallas) the members voted a new class of membership into the By-Laws. This new class of membership is known as Associate. It is the result of requests by the Local Sections to provide a means of recognizing the contributions of laboratory technicians working in the cereal industry.

Associate members may enjoy most of the privileges of regular AACC membership, with the exception of the right to hold national office and to vote in national elections. Associate members may, however, hold office in their Local Section.

Instead of receiving both CEREAL CHEMISTRY and CEREAL SCIENCE TODAY, Associate members receive only CST but may subscribe to CEREAL CHEMISTRY at the special member discount (50%). Because of the limitations of Associate membership, dues are less than those of regular or Active members ($7.50 vs $15.00).

Local Section officers should make a special effort during the coming months to recruit every eligible Local Section member who is not now a national member. The AACC provides a unique opportunity to continue one's professional growth and education after formal schooling has been completed. It offers a continuous program of refresher courses as well as advanced training via its publications, special workshops, and annual meetings. To grow professionally is everyone's goal. Membership in the AACC enables us to make this growth faster and with more ease.

JAMES W. EVANS

AACC TECHNICAL COMMITTEES, 1961-1962

Bread Staling
Lloyd B. Crossland, *Chairman;* Stuart B. Hughes, Noel H. Kuhrt, Karel Kulp, James W. Pence, O. Silberstein, Oscar Skovholt, Stanley Titcomb

Cake Flour Testing
W. T. Yamazaki, *Chairman;* Mark A. Barmore, James F. Conn, Henry H. Favor, Leo H. Fratzke, Harry J. Loving, Harry Miller, Jason A. Miller, Ralph S. Terrell, John P. Woolcott

Chemical Leavening Agents
Richard D. Haynes, *Chairman;* David K. Cunningham, Paul E. Kissel, Donald C. Meek, Paul E. Ramstad, Vincent Trexler, James W. Tucker

Cookie Flour
Vincent T. Vogt, *Chairman;* Leo H. Fratzke, F. Richard Fuhr, Harry Miller, Grant W. Pearcy, W. W. Prouty, Hamilton W. Putnam, Frank R. Schwain, Howard M. Simmons, Tod J. Stewart

Cracker Flour
Jan Micka, *Chairman;* Charles L. Ardinger, Richard T. Fukuda, William L. Heald, James S. Kelley, Marvin L. Lawrenson, Ray Mooi, Leland S. Thomson, Jarolsav Tuzar, A. Gordon O. Whiteside

Definition of Terms
Clinton L. Brooke, *Chairman;* C. G. Harrel, Charles N. Frey, P. F. Pelshenke, Edwin W. Ziegler

Edible Fat and Oils
Donald C. Meek, *Chairman;* R. L. Dowdle, Frank R. Schwain, M. J. Thomas, John F. Wintermantel, John B. Woerfel

Enzyme Assay
E. J. Bass, *Chairman;* B. Marlo Dirks, Marcel D. Labbee, Gerald Reed, O. Silberstein

Experimental Milling
Robert K. Bequette, *Chairman;* Harold K. Heizer, William C. Shuey, Leonard D. Sibbitt

Fat Acidity
Robert L. Glass, *Chairman;* Doris Baker, Eugene J. Guy, Howard Roth, Lawrence Zeleny

Flour Particle Size
Frank W. Wichser, *Chairman;* Paul R. Crowley, Ralph Gracza, Ben Grogg, Avrom R. Handleman

Flour Specifications and Approved Methods
(Chairman to be appointed) W. H. Cathcart, Gaston Dalby, James M. Doty, L. F. Marnett, R. W. Mitchell, F. D. Schmalz, Oscar Skovholt, Betty Sullivan, L. L. Warren, J. S. Whinery, E. L. von Eschen

Macaroni Products Analysis
Leonard D. Sibbitt, *Chairman;* C. C. Fifield, G. Norman Irvine, James J. Winston

Microorganisms in Cereal Products
Clyde M. Christensen, *Chairman;* Wm. D. Bradley, Wm. H. Cathcart, Gordon R. Christensen, C. G. Harrel, Henry H. Kaufman, Charles E. Neal, Hugh K. Parker

Mineral Analysis of Feedstuffs
Edward E. Chapman, *Chairman;* C. O. Gourley

National Check Sample
Lester H. Fischer, *Chairman;* Howard C. Becker, Lester J. Brenneis, James M. Doty, Donald K. Dubois, Robert L. Hoecker, Lawrence Iliff

Organic Acid Analysis
Clifford A. Watson, *Chairman;* David F. Houston, James F. Lawrence, Lazare Wiseblatt

Oxidizing and Bleaching Agents
Meade C. Harris, Jr., *Chairman;* D. K. Cunningham, Charles G. Ferrari, Kenneth A. Gilles, C. B. Gustafson, Isydore Hlynka, Virdell E. Munsey

Pesticide Residues
Warren O. Edmonds, *Chairman;* Edward E. Chapman, J. C. Enyart, Harold L. Marks, John H. Nelson, D. Paul Ochs, John Wintermantel

Physical Testing Methods
William C. Shuey, *Chairman;* Jerry Chawes, J. L. Croteau, John W. Giertz, I. Hlynka, Robert Laster, P. N. Leverentz, Lawrence Locken, D. K. Mecham

Proximate Analysis of Cereals
Paul J. Mattern, *Chairman;* Howard C. Becker, John

(Please turn to page 278)

INTERNATIONAL REPORTS

• • • **England**

THE CHORLEYWOOD BREAD PROCESS

The Chorleywood Bread Process is a batch method of producing good-quality bread and small goods with great reductions in time and cost.

It has been the opinion of the British Baking Industries Research Association for some years that the applied research program would eventually lead to the development of some new bread-making process which would offer marked commercial advantages over the present conventional methods. It is believed that this has now been achieved, and that in the Chorleywood Bread Process the baker has a means of producing a wide variety of first-quality bread and mall goods with great savings in time, space, and cost, coupled with increases in yield and production efficiency. These advantages are open to every baker, whatever his scale of production.

The cut surface of the 1¾ lb. Standard tin bread loaf produced by the Chorleywood Bread Process within 1½ to 2 hrs. of starting work.

The Process eliminates the need for bulk dough fermentation and involves the intense mechanical working of the dough at a set degree, oxidizing treatment, and slight recipe adjustments. The bread produced compares favorably in every respect with conventional bread and has none of the undesirable characteristics usually associated with a no-time dough process.

Among the varieties which have been made at Chorleywood are Standard tin bread, Batch bread, Wheatmeal, Wholemeal, Bloomers, Coburgs, Vienna bread, Milk bread, soft rolls, and buns. The saving in production time is illustrated by the fact that, with the exception of batch bread, any of these varieties can be produced within 1¼ to 2 hrs. of beginning work. Even batch bread may be produced in an overall time of 2½ hrs.

Selection of the varieties produced by the Chorleywood Bread Process.

The saving in space resulting from the elimination of bulk fermentation is considerable. Temperature and humidity control of dough rooms becomes unnecessary. There is an increase in yield, partly because fermentation and evaporation losses are eliminated, and partly because extra water and yeast are needed.

The net gain should be about 0.6c per sack of standard bread, and correspondingly higher for speciality breads.

Consumer preference trials, using panels of 40-45 people, and comparing bread from the Process with conventional, fermented bread, revealed no detectable differences between the two.

Members of the Research Association are being given full details of the Process in a report which is now ready and for which they are invited to apply. The report also includes technical details of the system used to measure the work expenditure needed and a discussion of the legal position on the use of oxidizing agents.

Readers of THIS JOURNAL *who are interested in obtaining further information about the Chorleywood Bread Process may write to the British Baking Industries Research Association, Baking Industries Research Station, Chorleywood, Hertfordshire, England.*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W. Giertz, Lawrence Iliff, Gerald D. Miller, Claude D. Neill, Jeff S. Schlesinger, Elden Smurr

Proximate Analysis of Feedstuffs
Gerald D. Miller, *Chairman;* Charles S. Fudge, Eugene Kerr, J. G. Kurdydyk, Joseph E. MacMillan

Revision of Cereal Laboratory Methods
Majel M. MacMasters, *Chairman;* Welker G. Bechtel, Edith A. Christensen, Kenton L. Harris, Raymond J. Tarleton, John F. Wintermantel

Sampling of Cereal Products
Morris H. Neustadt, *Chairman;* Maxwell L. Cooley, Lawrence Zeleny

Sanitation Methods
Thomas H. McCormack, *Chairman;* Elsie Andrina, Bertha M. Anzulovic, John V. Corbishley, Ross H. Cory, Marion Dockett, Robert Kilborn, Paul M. Marek, O'Dean L. Kurtz, Joseph L. Owades, Leota B. Parrack, Jeff Schlesinger

Sedimentation
Walter T. Greenaway, *Chairman;* Donald C. Abbott, Marvin E. Armour, Edward E. Chapman, Howard C. Becker, John W. Giertz, William L. Heald, James L. Lamkin, Edward Liebe, Claude D. Neill, D. Paul Ochs, Jeff S. Schlesinger, Louis E. Schonlau, Elden Smurr, Martin Wise

Soybean Analysis
Endre Sipos, *Chairman;* Ernest F. Budde, J. C. Enyart, K. E. Holt, B. Landfried, E. K. Olson, Herbert C. Schaefer

Sub-Committee AOCS and AACC
Liaison for determination of water-soluble protein
Endre Sipos, *Chairman;* K. E. Holt, J. C. Enyart representing AACC; M. W. Dippold, G. H. Kyser, representing AOCS

Starch and Pentosan
Walter S. Hale, *Chairman;* E. J. Bass, J. V. Corbishley, Sheldon I. Greenberg, William R. Meagher

Statistics and Experimental Error
John P. Woolcott, *Chairman;* Clinton L. Brooke, William Drakert, Harold N. Haney, W. O. S. Meredith, Roy L. Sampson

Sugar Analysis
Robert J. Dimler, *Chairman;* Charles B. Broeg, Kenneth A. Gilles, Robert B. Koch, Robert J. Smith

Test Baking
Leslie D. Longshore, *Chairman;* Donald C. Abbott, Elwood C. Edelman, Jacob Freilich, Donald W. Hatch, Donald E. Meisner, Henry Solle, S. N. Vilm, W. H. Ziemke

Vitamin and Mineral Analysis
C. Henry Allen, Jerry Chawes, Donald B. Davis, Beate Feller, C. B. Gustafson, John J. Kagan, David L. Kinnally, Robert M. Knecht, James H. Panton, Mary Regulski, E. DeRitter, C. C. Tsen

Yeast Leavened Flavor
Simon S. Jackel, *Chairman;* Roy C. A. Bradshaw, Robert H. Cotton, B. Marlo Dirks, Bernard J. Entner, Charles Feldberg, Jacob Freilich, Eugene F. Garner, Stanley A. McHugh, Morris W. Mead, Byron S. Miller, Jack E. Miller, Chester W. Ofelt, James W. Pence, Norman Potter, Gerald Reed, Robert D. Seeley, Oscar Skovholt, James L. Vetter, Emily L. Wick, Lazare Wiseblatt

Sub-Committees
Selection of Committee Name: Bernard J. Entner
Glossary and Technology: Chester W. Ofelt
Standardized Test Material: Lazare Wiseblatt

Yeast-Raised Products
David E. Downs, *Chairman*
(Stand-by Basis)

• • • People

Richard E. Berg named manager central bakery flour sales, The Pillsbury Co., formerly product manager; from administrative assistant and bakery products sales positions. **Blair Hackney** appointed manager, Southern bakery flour sales, from regional manager for bakery flour sales, Kansas City; formerly with Blair Milling Co., Atchison, Kan. **John E. Thomson** named manager, bakery flour sales promotion; joined Pillsbury in 1954 as institutional salesman in Cincinnati, Ohio; held field sales positions in bakery products. All three will be headquartered in Minneapolis.

Patricia D. Cummisford joins staff of General Mills, Inc., at James Ford Bell Research Center, Minneapolis, as project leader in exploratory food research dept. **Byron S. Miller** joins same staff as principal scientist; has been research chemist in Cereal Crops Research, USDA, and professor, Flour and Feed Milling Industries dept., Kansas State Univ., Manhattan.

John A. Johnson, Kansas State University Flour and Feed Milling Industries Dept., appointed to the National Academy of Science's Committee on Cereals. The past president of the AACC will be one of the five men who will advise the government on nutritional aspects of cereals. He will also represent the AACC on the Committee.

Murray G. Madden, director of the Brewing and Malting Barley Research Institute since 1958, died at age 49 in Winnipeg Aug. 2 after a short illness.

Roy N. Nevans appointed vp in charge of sales at Henningsen Foods, Inc. Since joining the company in 1957, he has served as general sales manager and director of foreign operations.

• • • Products

• **Guide to better beef.** Designed as a guide to the most profitable methods of getting the maximum out of every feed dollar, a new booklet on beef cattle feeding has been published by the Merck Chemical Division.

Among subjects covered in the publication are ration building, nutritional needs, vitamin A, and management. Reference tables and charts are also included. **(1)**

• **Instrument, apparatus, and chemical catalog.** E. H. Sargent & Co. is distributing catalog 109, named for the number of years the company has been in business. Among the features of the 1,440-page volume are alphabetical listings, each with a boldface heading and an individual stock number in sequence. Subject-finding words are printed at the top of each page and similar items are grouped together on the page. Virtually every instrument, article, or apparatus is individually illustrated to show all distinguishing differences. **(2)**

• **Small all-purpose lamp.** This sub-miniature utility lamp, Model 5979, is manufactured by Tensor Electric Development Co., Inc. In folded position it is 3 in. high, 7 in. long, and 2 in. wide; in extended position is 12 in. tall. **(3)**

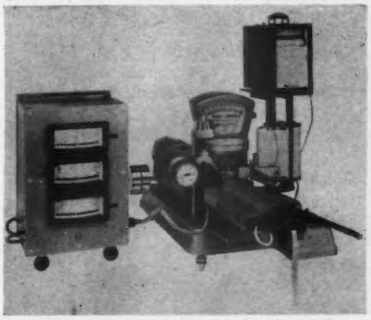
• **A new corn syrup,** with a high proportion of its solids at the disaccharide level and a low proportion in the intermediate molecular weights, has been developed by Corn Products Co.

The syrup is manufactured by a dual conversion process which radically alters the carbohydrate composition usually found in corn syrups. The product has a maltose content of approximately 45% of total solids. The new Mor-Sweet brand is also said to have exceptional resistance to color development during heating. **(4)**

• **Bulletin 795,** a new pocket-size bibliography on ultraviolet, visible, and near-infrared spectroscopy, has been published by the Scientific and Process Instruments Division of Beckman Instruments, Inc.

The 36-page booklet contains more than 250 references under the headings General, Technique, and Application. **(5)**

• **An extruder measuring head** for its Plasti-Corder has been introduced by C. W. Brabender Instruments, Inc. Newest of a variety of attachments, the ¾ in. extruder is designed to measure and record torque required to process polymers under a wide range of screw speed rates and barrel zone temperatures.



The product is described as having two electrically heated barrel zones and a selection of interchangeable electrically heated dies. Three electronic proportioning controllers regulate and maintain zone and die temperatures. **(6)**

• **New pancoating process.** Candy, gum, and other similarly produced food products can now be coated and ready for packaging in as little as four hours with a minimum of four to six subcoating applications according to Foremost Dairies.

Observations

Because our mention of insect and larva slides in the last issue lacked clarity we are repeating the information in more detail. The slides listed below were prepared by San Serv, Inc., and are expertly done. No laboratory doing sanitation analysis should be without these very helpful reference tools. We appreciate the many inquiries already received. The following color slides are available:

	No. in Set	Price Per Set
Sawtoothed Grain Beetles (adult and larva)	30	$75.00
Flat Grain Beetle (adult and larva)	22	55.00
Lesser Grain Borer (adult and larva)	25	62.50
Tribolium Flour Beetle (adult and larva)	33	82.50
Rice and Granary Weevils (adult and larva)	36	90.00
Cigarette Beetle (adult and larva)	11	48.00
Drug Store Beetle (adult and larva)	5	
Cadelle (adult and larva)	8	24.00
Dried Fruit Beetle (adult)	4	50.00
Black Carpet Beetle (larva)	4	
Larder Beetle (larva)	4	
Carpet Beetle (larva)	7	
Meal Moth (larva) Common to both Mediterranean and Indian Meal Moth	4	45.00
Storage Moth	1	
Angoumois Grain Moth (adult, larva, and pupa)	6	
Mediterranean Flour Moth (adult and larva)	2	
Indian Meal Moth (adult and larva)	2	
Drosophila Fly (adult, larva, and pupa)	9	27.00
Thrips	5	39.00
Aphids	4	
Psocid	3	
Mite	1	

Prices range from $2.00 to $3.50 per slide depending on quantity ordered.

Jim Doty

DOTY
Laboratories

1435 Clay St.,
North Kansas City 16, Mo.

This pancoating innovation uses a rapid build-up of subcoatings and elimination of the grossing and color steps, made feasible by the free-flowing properties of Lactose Edible. **(7)**

Readers interested in obtaining more information on the above items are invited to use the convenient reply card.

• • • Patter

A leading processor and dryer of chili peppers since 1919, Chili Products Corp., Ltd., Los Angeles, has been acquired by Red Star Yeast & Products Co. and will operate as a division of the Milwaukee firm.

Chili Products produces chili powder, chili pepper, and California paprika; also imports a complete line of spices and herbs. It is the second company acquired this year by Red Star as part of its announced program of expansion and diversification in the food field. Previously the company bought Universal Foods Corp. of Chicago, a manufacturer of institutional food products.

• • •

Corn Industries Research Foundation, Inc., Washington, D.C., was selected as one of three grand award winners by the American Society of Association Executives for outstanding public service programs.

CIRF was cited for its "contribution in revising and publishing standard analytical procedures for research in the corn-refining industry."

• • •

Feed and milling technology scholarships at Kansas State University will total $7,650 during the current year according to John A. Shellenberger, head of the Flour and Feed Milling Industries Dept.

The industry funds will provide for 12 feed technology scholarships and 8 milling technology awards. Fourteen of the scholarships are renewals.

• • •

The Manufacturing Chemists' Association recently prepared and released a comprehensive bibliography on food additives. It is entitled "Some Sources of Information on Food Technology, Including Food Additives."

Requests for single copies will be honored without charge when received from individuals on institution or organization letterhead. Address requests to: Manufacturing Chemists' Association, Inc., 1825 Connecticut Ave., N. W., Washington 9, D. C.

• • •

"The Role of Nutrition in International Programs" is the new brochure available from the Food and Nutrition Board. Copies can be obtained from the Board at 2101 Constitution Ave., Washington 25, D. C.

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SITUATIONS OPEN

CHEMIST OR FOOD TECHNOLOGIST for Quality Control in Cookie Manufacturing. Two years minimum experience. Must be agreeable to relocate, Chicago or New York area. Salary to $8,000. Submit resume, references, and college transcript. Reply to: Dept. 10A, CEREAL SCIENCE TODAY, 1955 University Avenue, St. Paul 4, Minnesota.

Applied Research Associate Opportunity. Seeking experienced man with background in flour milling. Prefer Kansas State Milling Industries, Chemical Engineering or Mechanical Engineering education. Contact A. A. Ackels, Bay State Milling Co., Winona, Minn.

ERRATUM

Cereal Science Today,

September 1961 issue (Vol. 6, No. 7)

The last paragraph on page 21[?] under "(2) action was taken . . . should have read "to develop scientific data for action before March 6, 1960."